

ENVIRONMENTAL PERMIT APPLICATION DESIGN INFORMATION
MOORING DESIGN
NORFOLK NAVAL STATION

1.0 BACKGROUND

Due to the attack on the USS COLE, harbor protection measures are being implemented at US Navy sites to establish a security zone and to provide protection to waterfront personnel, facilities and assets. Various boat barriers are being designed and moored to aid in harbor protection.

An environmental assessment (EA), dated Dec 13, 2003 (reference (a)), has been completed for the installation of a waterfront barrier system consisting of a floating barrier system along to Norfolk Naval Station Waterfront (see Figure 1).

2.0 PROJECT OVERVIEW

The waterfront boat barriers shall be secured to an embedded plate anchor mooring system. These plate anchors have been installed to secured waterfront barrier systems off Naval Air Station North Island and Naval Base Point Loma in San Diego. Plate anchors have also been used to install over 300 moorings for the US Navy and other Government and state agencies to include over 60 recently installed on the James River in Fort Eustis, VA and 1 plate anchor in the Golf Anchorages along the Norfolk Harbor Reach.

A plate anchor mooring system offers the following advantages:

- High holding capacity to weight ratio. A 5'x6' plate anchor (2.5 tons) can provide up to 225 tons capacity in a med sand equivalent to a 37.5 ton drag anchor.
- Can handle uplift forces allowing for a shorter scope of chain. Drag anchors need long scopes of chain or additional sinkers to reduce uplift forces at the anchor
- Mooring can accommodate loads from any direction using a single riser chain between anchor and buoy eliminating need for multiple ground legs.
- Less mooring material required reducing material costs and costs for future inspections.
- Lower costs to install plate anchor system than a mooring dolphin system.



FIGURE 1 – NORFOLK NAVAL STATION WATERFRONT

3.0 PLATE ANCHOR INSTALLATION

Plate anchors are an embedment type anchoring system that is driven below the seafloor to a specified depth. They are initially driven and installed in an “end-on” orientation. A vertical pull is then applied through the connected chain to proof and rotate the anchor to a horizontal orientation. The plate anchor provides holding capacity by bearing up against the soil. Plate anchors are relatively inexpensive and are installed using conventional marine offshore equipment to what would be used to install piles for a typical pier.

Figure 2 provides a photograph of the plate anchors that would be used at Naval Station Norfolk, VA. Figure 3 provides dimensional information for the plate anchor. Figure 4 shows other similar plate anchors installed at various locations.



FIGURE 2 – BARRIER PLATE ANCHORS

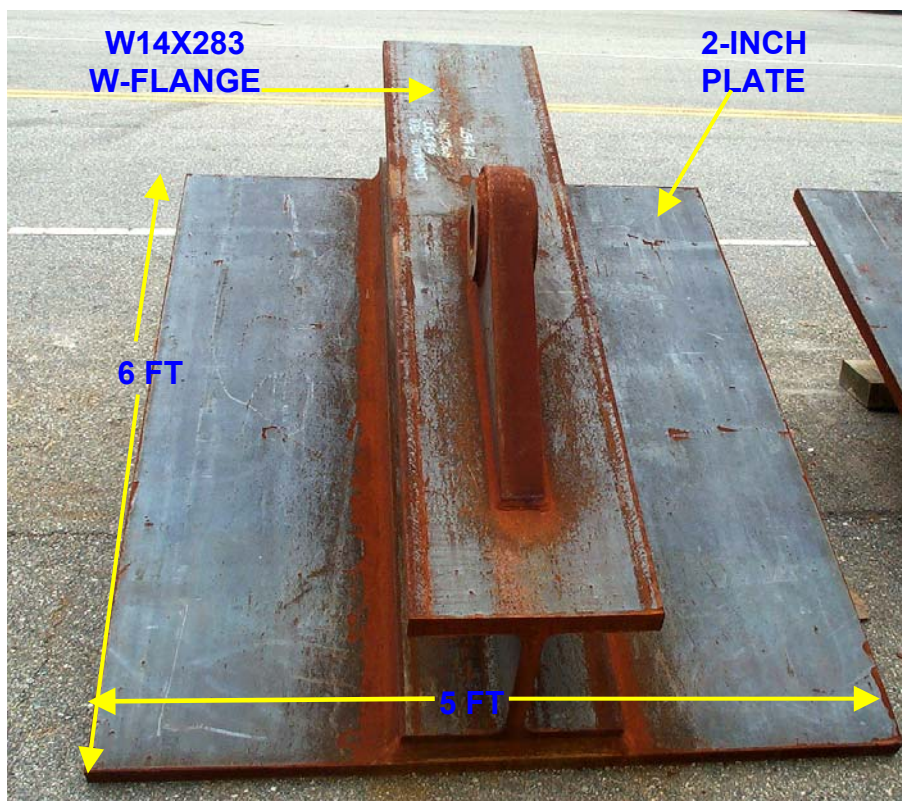


FIGURE 3 – PLATE ANCHOR DIMENSIONS

Plate anchors are installed in the following sequence:

1. A derrick barge is positioned by the anchor location and secured using spuds or a 4-point mooring arrangement. Spill kits and absorbent booms will be present.
2. The plate anchor is driven through the seafloor to a specified depth (120 feet below MLLW) into the seafloor using a pile driving hammer and a follower (see step 1 of Figure 5). The plate anchor is a rectangular shaped plate made of steel that has a W-flange welded to it and a padeye welded onto the top of the W-flange. The W-flange provides strength and the padeye is for attaching the mooring chain. The follower is a Wide-flange beam segment that has a sleeve at its lower end to secure the plate anchor to it. The chain is attached to the plate anchor and the anchor secured into the follower. It is then lowered vertically in the water and a pile driving hammer is placed on top of the follower. Both impact and vibratory hammers (for sandy soils) can be used to install the plate anchor. The anchor/follower is driven using standard pile driving hammers and leads. Once the plate anchor has been driven to the specified depth, the follower is removed by either pulling up on the follower or using an extractor type hammer (see step 2 of Figure 5).

3. The anchor is then proof-tested by applying tension to the free end of the mooring chain in a vertical direction. This causes the anchor to rotate toward a horizontal position and obtain its holding strength (see step 3 of Figure 5). In numerous cases, the anchors do not even key, or partially key, indicating that the soils are stronger than anticipated.

4. The mooring chain is then is routed through the center hawse pipe of the buoy and secured on top of the buoy.

Figure 5 shows the general installation steps for a plate anchor. Ffigure 6 shows a plate anchor system in preparation for installation at another Naval Station. Figure 8 shows a sketch of the proposed plate anchor barrier moorings.

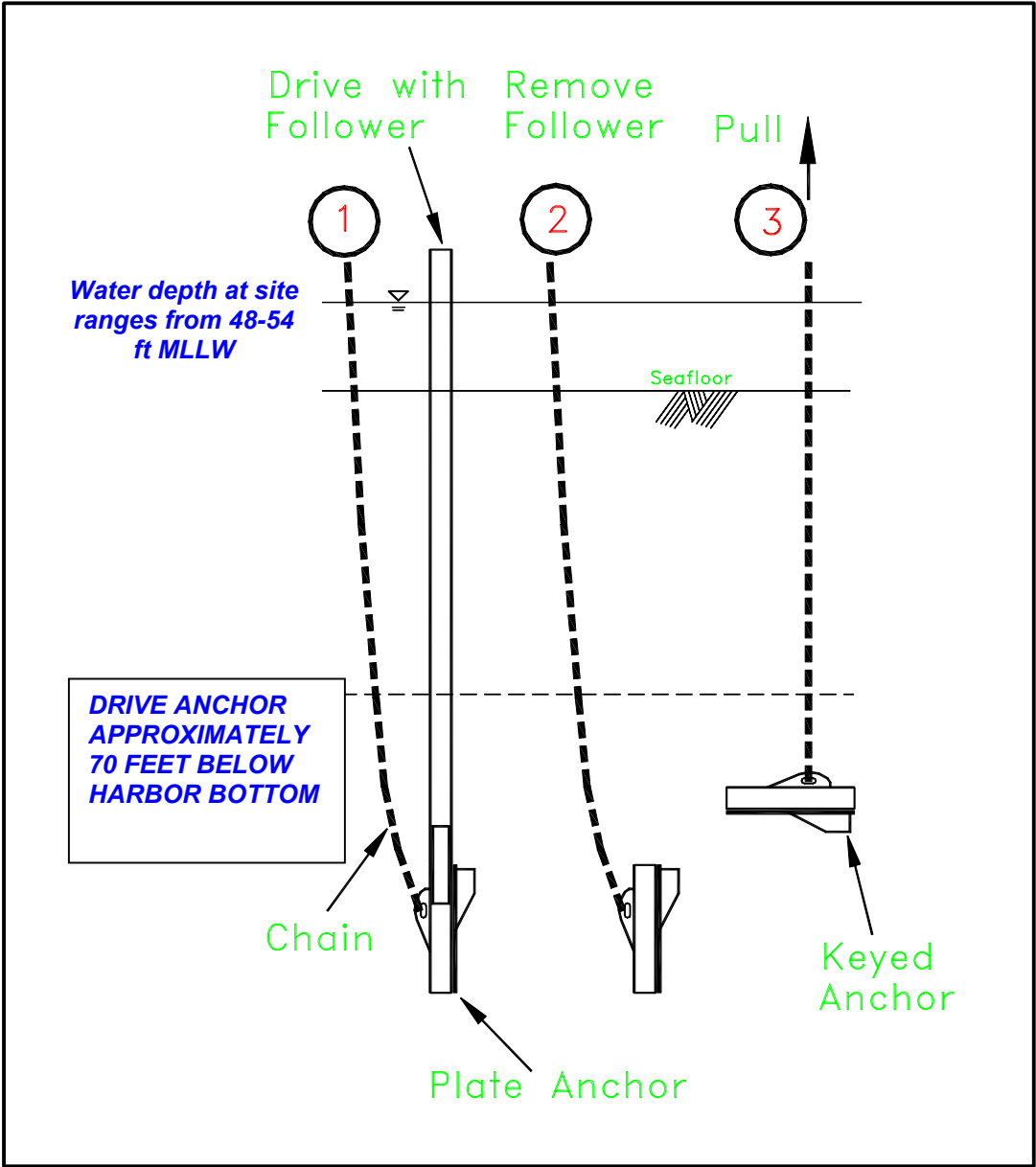


FIGURE 5 – Plate Anchor Installation



FIGURE 6 – *Plate Anchor Installation*

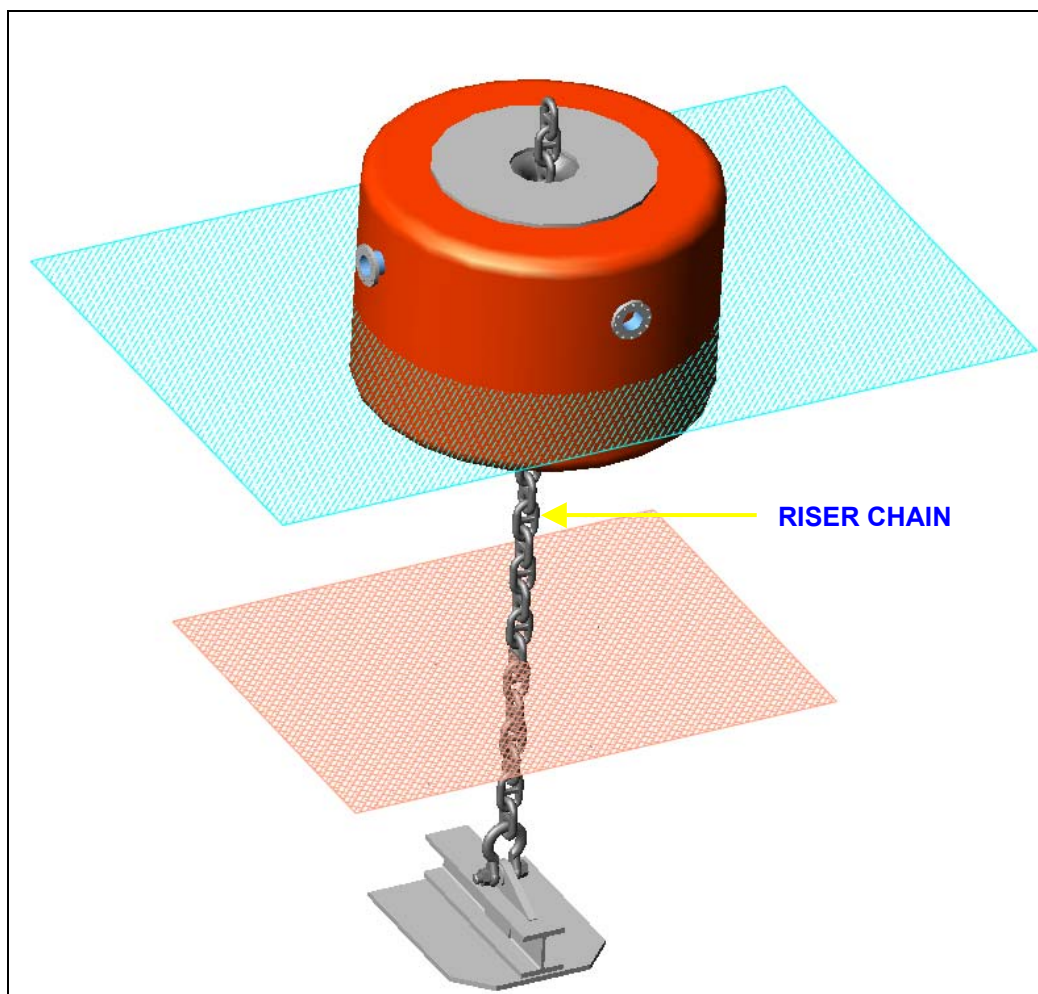


FIGURE 7 – Plate Anchor Mooring Configuration

4.0 MOORING COMPONENTS

Mooring components will consist of American Bureau Of Shipping Grade 3 (ABS 3) mooring chain, ABS 3 chain and anchor joining links, Crosby anchor bolt or screw pin shackles and a polyurethane foam filled mooring buoy. Figure 8 shows a photograph of the mooring buoy. Figure 9 shows the mooring riser chains.



FIGURE 8 – Barrier Mooring Buoy



FIGURE 9 – Mooring Chain

5.0 BARRIER LIGHTING

A navigation light for each buoy is specified. A Carmanah Model 601 light having a 2 nautical mile visibility range is shown in Figure 10 below. These lights are solar powered and automatically turn on at dusk and off at dawn. They are available in several colors and flash patterns to meet US Coast Guard lighting requirements. They have a 5 year life cycle, are maintenance free and are environmentally safe since there is no requirement for on site battery replacements.

A mount will be provided to secure the navigation light on each buoy similar to those installed at barrier buoys at San Diego (Figure 11).

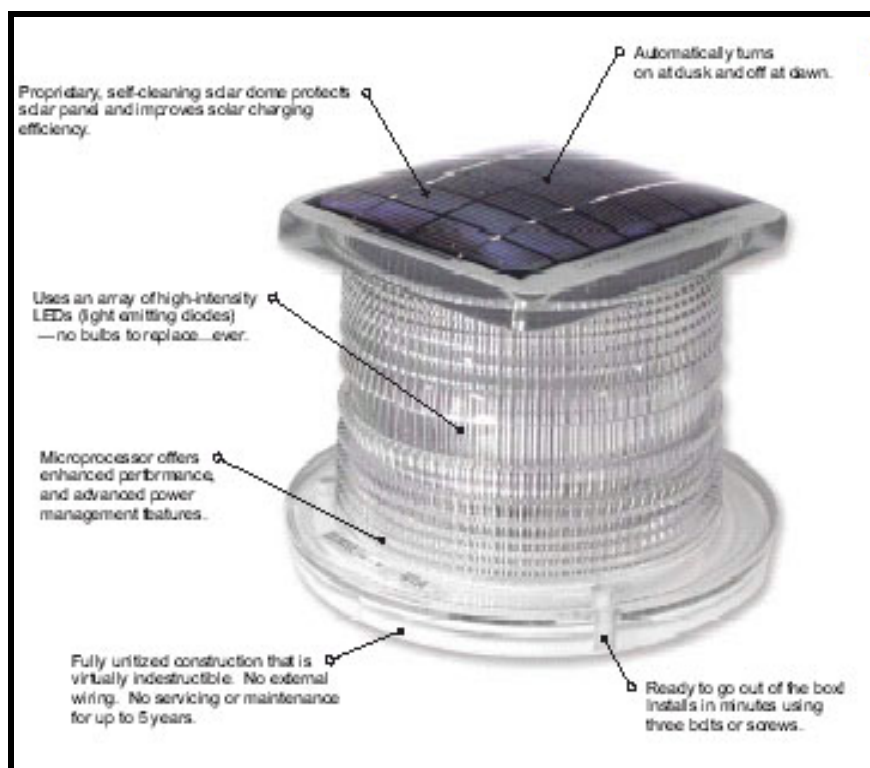


FIGURE 10 – Carmanah Light

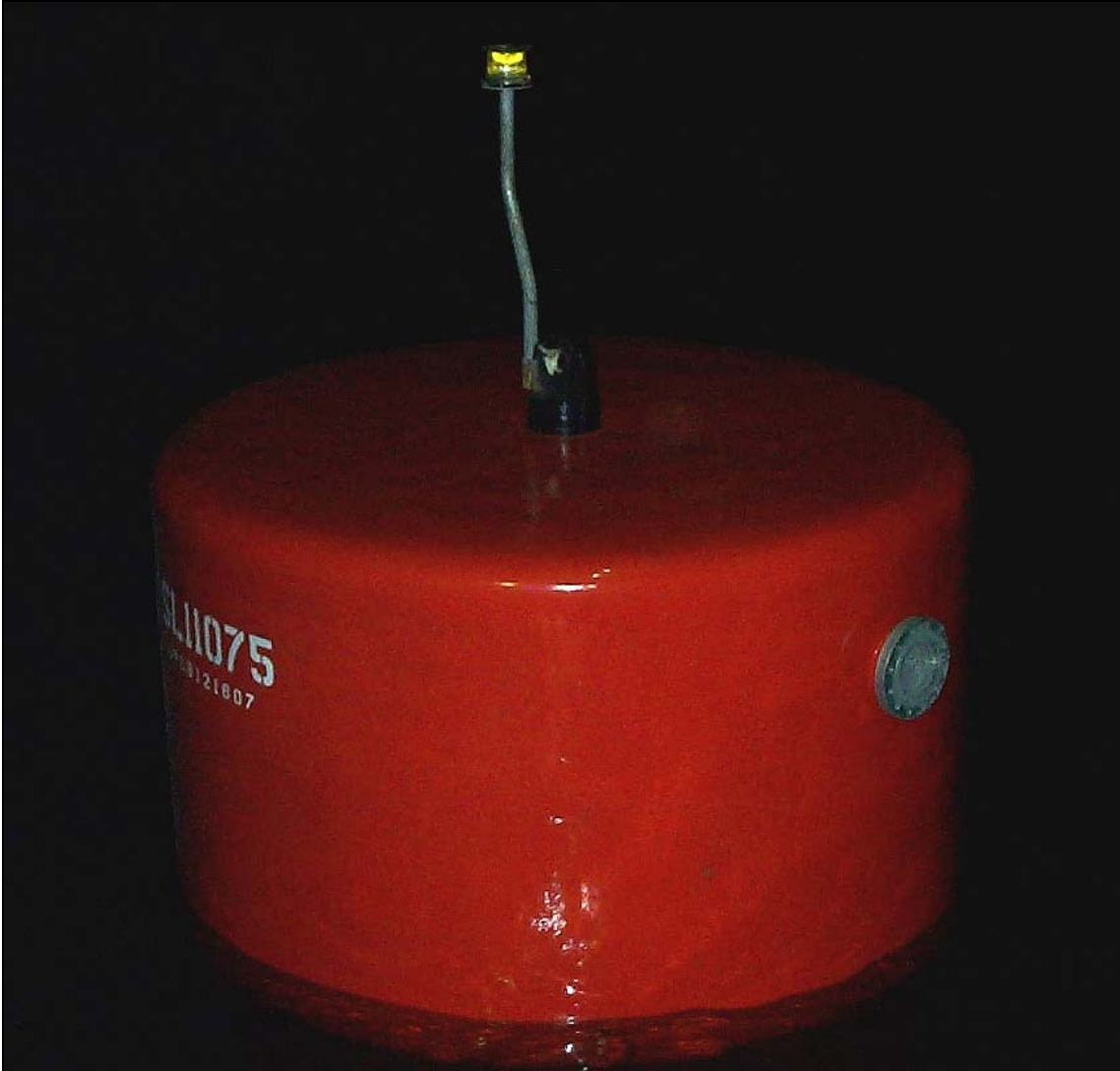


FIGURE 11 – *Navigational Light On Buoy*

6.0 DEADMAN ANCHORS

At the northern and southern moorings a back stay mooring leg will be attached below the mooring buoy to aid in keeping the mooring buoy off the corner of Terminal B or the Breakwater. The deadman anchor consists of a 20-ton concrete clump (Figure 12) with a length of small mooring chain.



FIGURE 12 – Concrete Clump

7.0 DESIGN COORDINATES FOR BARRIER SITES

The barrier layout is shown in Figures 13-16. Design anchor coordinates, based on geodetic coordinates, Latitudes and Longitudes, World Geodetic System 1984 (WGS 84) (in degrees-decimal minute) as well as Northings and Eastings, Virginia State Plane South North American Datum 1983 (NAD83) US Feet are shown in Table 1.

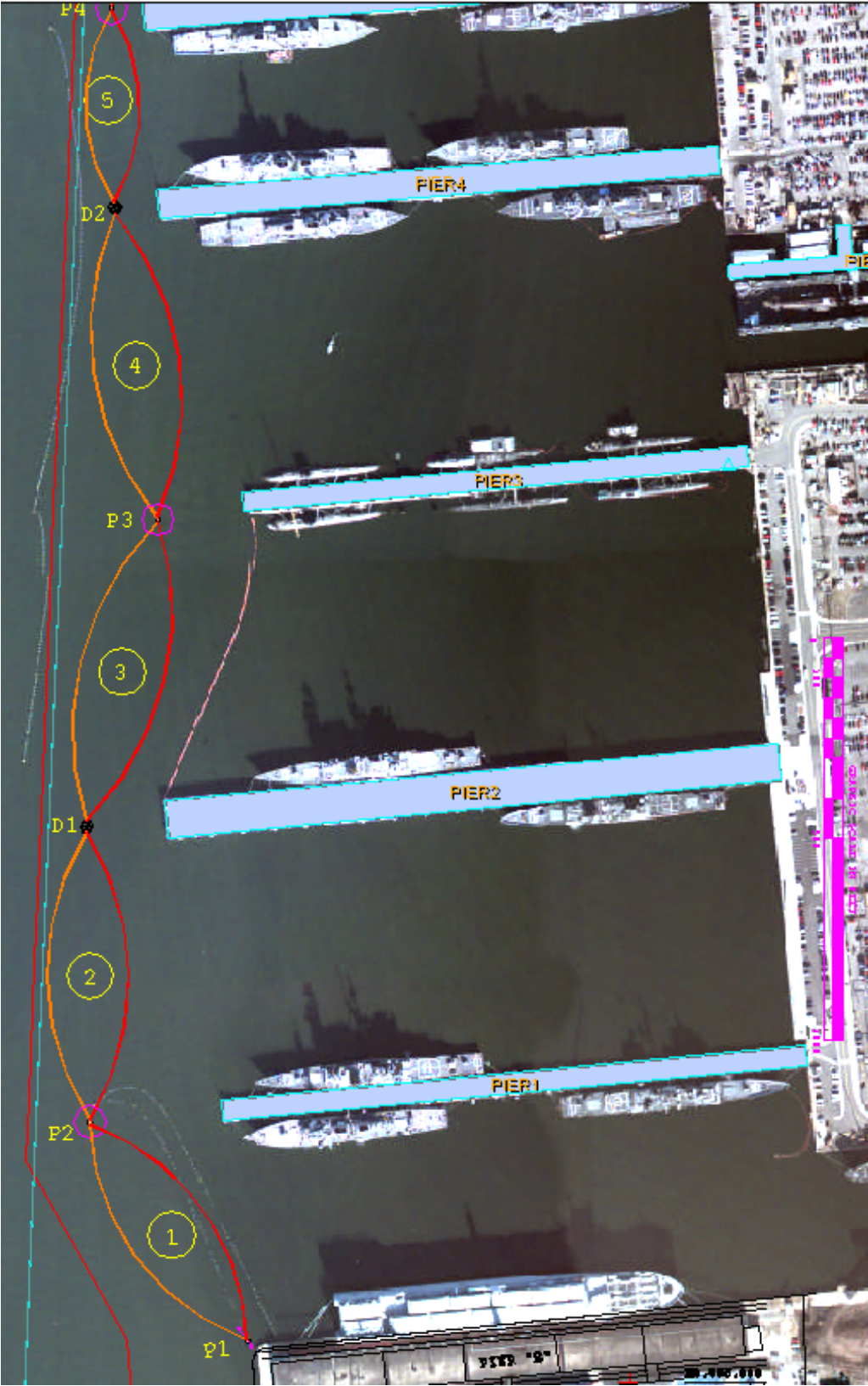


FIGURE 13 – Barrier Layout Piers 1-4

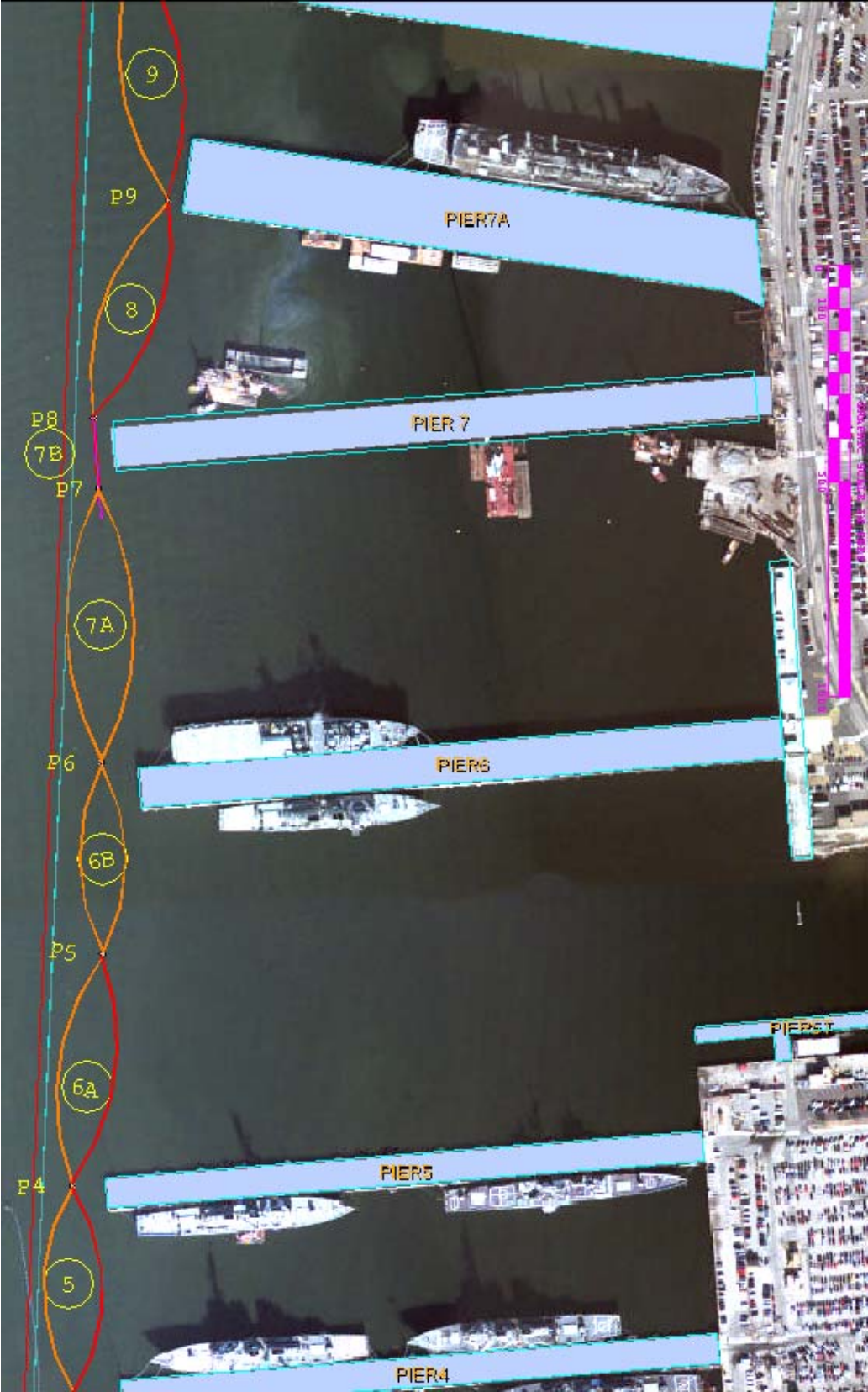


FIGURE 14 – Barrier Layout Piers 5-7

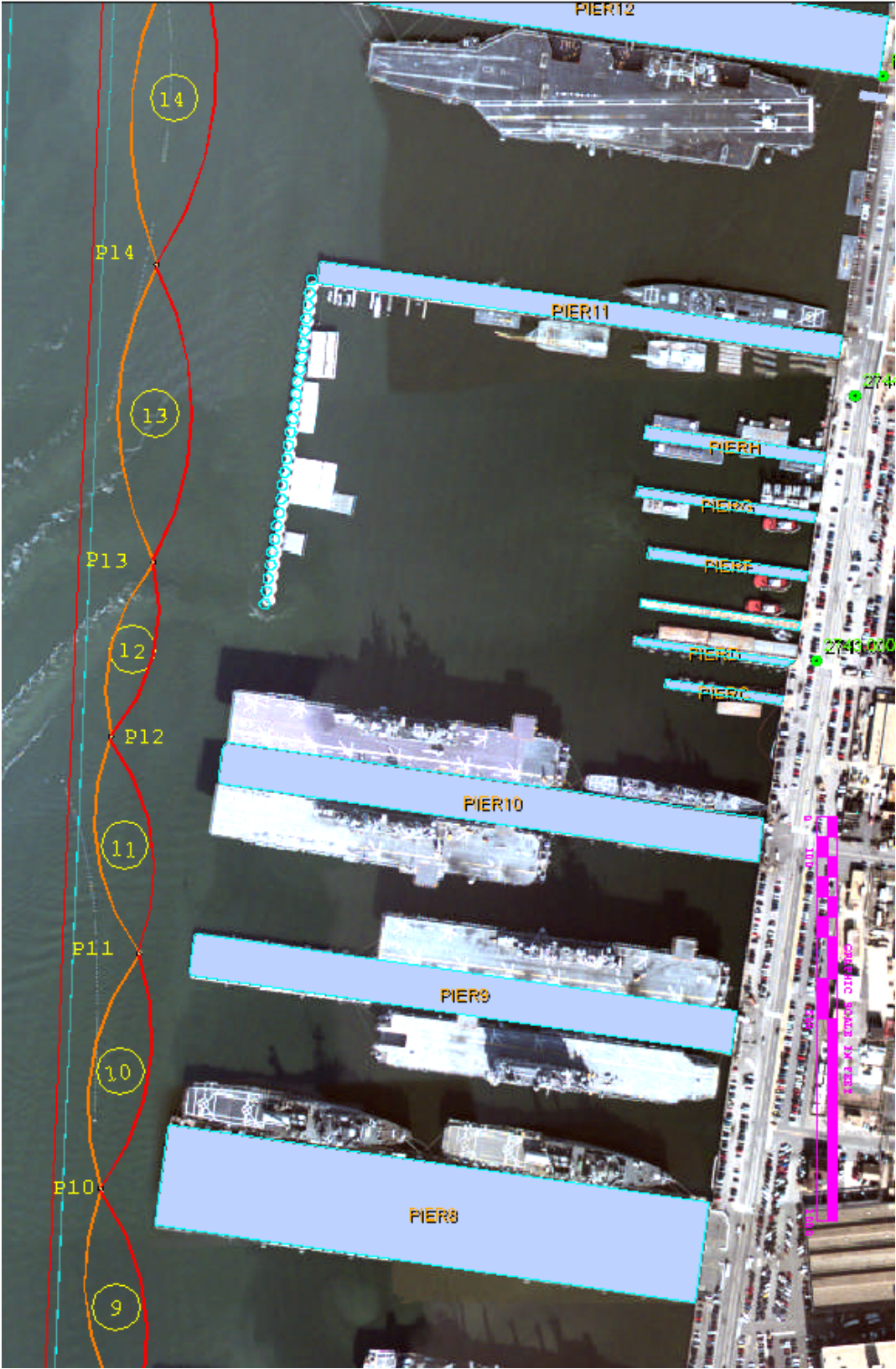


FIGURE 15 – Barrier Layout Piers 8-11



FIGURE 16 – Barrier Layout Piers 12-14

TABLE 1**NORFOLK WATERFRONT BARRIER PLATE ANCHOR LOCATIONS**

ID	NORTHING US FEET	EASTING US FEET	LATITUDE ⁽¹⁾ DD.MMSSSSS	LONGITUDE ⁽¹⁾ DD.MMSSSSS
P1 BUOY	3506100.04	12116054.43	N 36.5555540	W 76.2001103
P1	3506086.99	12116063.69	N 36.5555409	W 76.2000992
P1 CLUMP	3506132.66	12116031.28	N 36.5555868	W 76.2001378
P2	3506645.07	12115662.55	N 36.5601017	W 76.2005774
P3	3508141.27	12115830.47	N 36.5615769	W 76.2003283
P4	3509411.23	12115715.86	N 36.5628349	W 76.2004335
P5	3509947.29	12115787.2	N 36.5633631	W 76.2003306
P6	3510391.92	12115786.32	N 36.5638027	W 76.2003191
P7 BUOY	3511028.87	12115778.29	N 36.5644325	W 76.2003110
P7	3510962.57	12115783.4	N 36.5643669	W 76.2003066
P8 BUOY	3511190.39	12115765.85	N 36.5645925	W 76.2003217
P8	3511256.69	12115760.74	N 36.5646581	W 76.2003262
P9	3511696.05	12115939.54	N 36.5650884	W 76.2000936
P10	3512279.88	12115864.22	N 36.5656672	W 76.2001698
P11	3512861.03	12115957.98	N 36.5702396	W 76.2000379
P12	3513395.02	12115889.18	N 36.5707690	W 76.2001075
P13	3513826.96	12115994.25	N 36.5711936	W 76.1959660
P14	3514560.04	12116001.87	N 36.5719181	W 76.1959357
P15	3515384.94	12116086.31	N 36.5727316	W 76.1958085
P16	3516255.94	12116098.84	N 36.5735923	W 76.1957684
P17	3517637.87	12116570.24	N 36.5749476	W 76.1951486
P17 BW ANCHOR	3517778.68	12116701.78	N 36.5750838	W 76.1949825

Note (1) 36.4523456 is read 36° 45' 23.456"

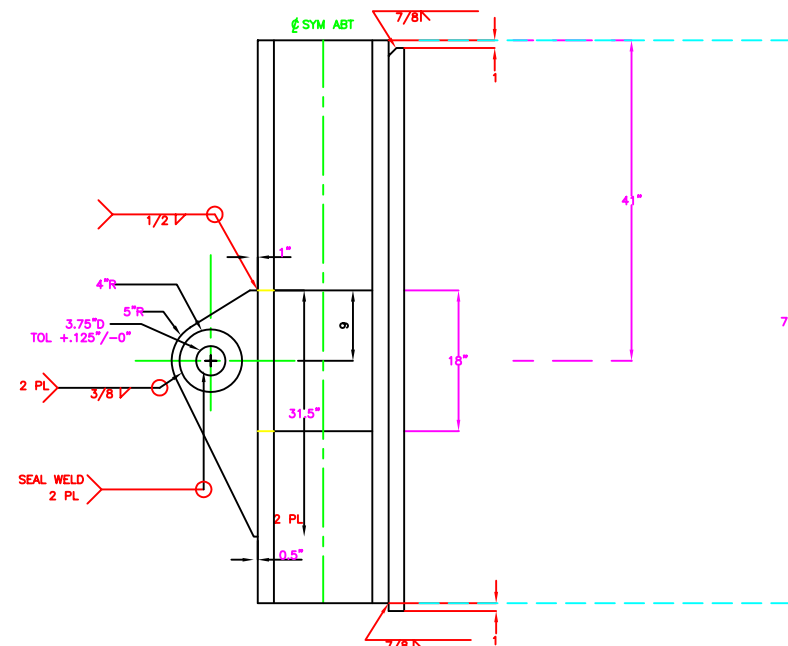
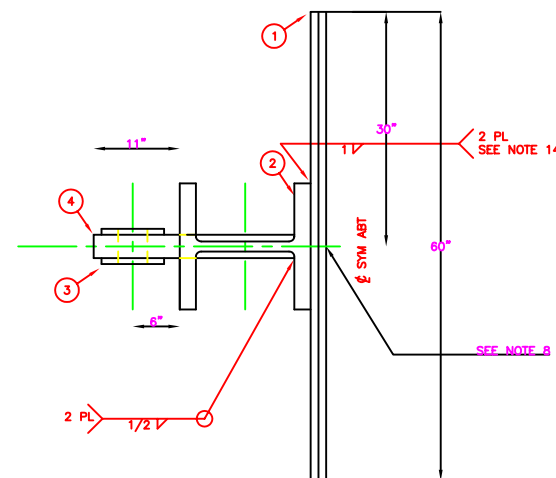
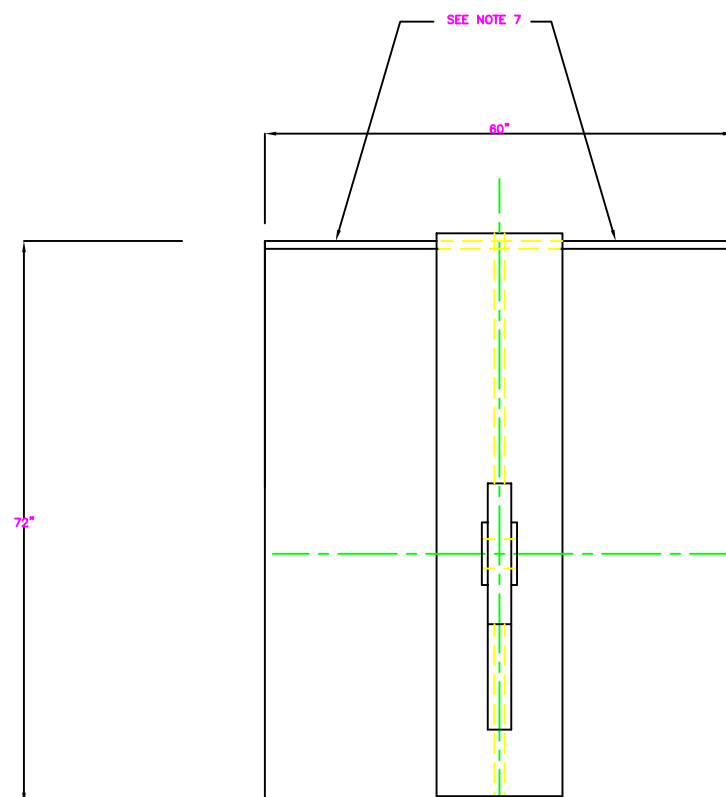
8.0 CONTACT INFORMATION

Myself or Mr. Bill Seelig can be reached at (202) 433-5335 (2396) or steve.a.cohen@navy.mil (William.n.seelig@navy.mil) if further information is required.



STEVEN COHEN

GRAPHIC SCALE



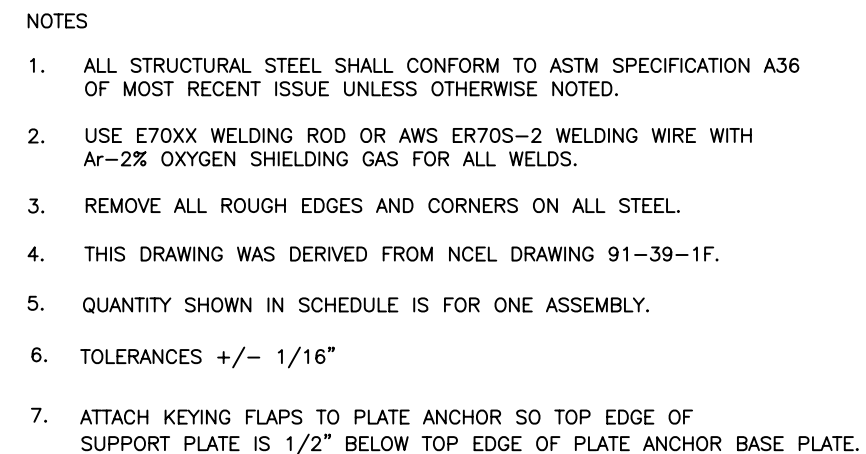
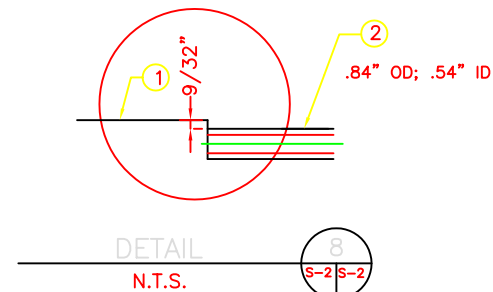
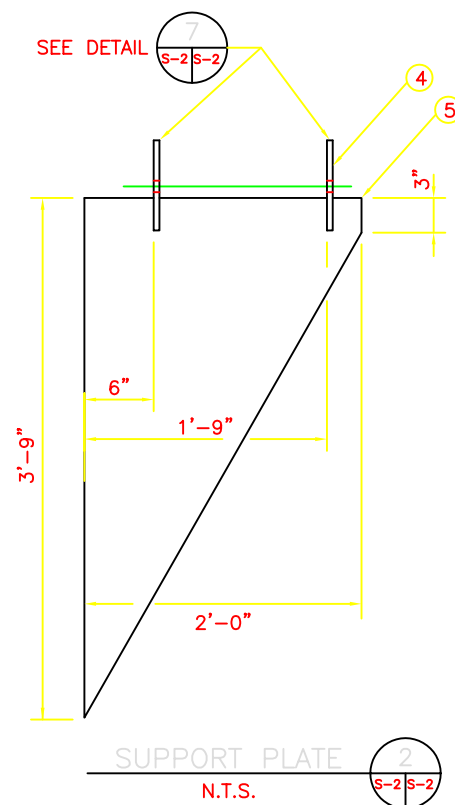
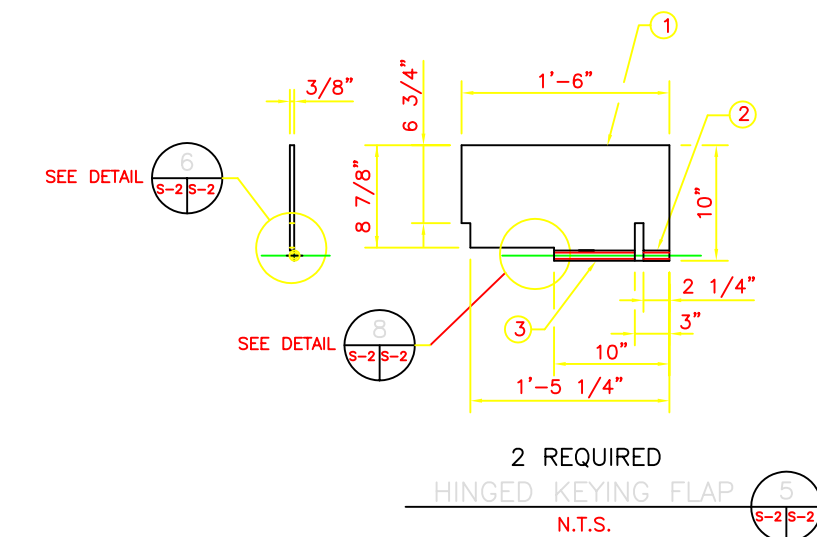
1. ALL DIMENSIONS IN INCHES WITH A TOLERANCE OF ± 0.125 INCHES, UNLESS OTHERWISE NOTED.
2. ANCHOR STRUCTURALLY DESIGNED FOR 300 KIPS (1335 KILO NEWTONS).
3. USE WITH CROSBY 3.5-INCH NOM, G-2140 SHACKLE OR APPROVED EQUAL.
4. CUT SLOT IN FIND NO. 3 TO ACCEPT FIND NO. 4.
5. USE E70XX WELDING ROD OR AWS ER70S-2 WELDING WIRE WITH Ar-2% OXYGEN SHIELDING GAS FOR ALL WELDS, OR APPROVED EQUAL.
6. ALL WELDING AND INSPECTION SHALL BE IN ACCORDANCE WITH AWS D1.1 (LATEST EDITION). INSPECTION REQUIRED INCLUDES:
 - MT ROOT PASS.
 - MT FINISHED WELD.
7. INCLUDE A 1 INCH X 45 DEGREE BEVEL.
8. KEYING FLAPS ADDED, SEE SHEET S-2.
9. QUANTITY SHOWN IS FOR ONE PLATE ANCHOR.
10. SEQUENCE OF WELDING SHALL BE SUCH AS TO MINIMIZE THE RESIDUAL STRESSES IN THE STEEL.
11. ALL GROOVE WELDS MUST HAVE THOROUGH PENETRATION AND ABSOLUTE FUSION.
12. REMOVE ALL ROUGH EDGES AND CORNERS ON ALL STEEL.
13. PREHEAT BASE PLATE WHEN WELDING I-BEAM ONTO BASE PLATE.

PART LIST, 5 FT X 6 FT PLATE ANCHOR				NAVAL FACILITY REMARKS OF THE WORK	NAVAL STATION
4	1	PLATE 3.00" STOCK	A572, GRADE 50		
3	1	W 14 X 283 X 72"	A572 GRADE 50 SEE NOTE 4		
2	2	PLATE .75" STOCK	A572, GRADE 50		
1	1	PLATE 2.00" X 60" X 72"	A572, GRADE 50		
FIND NO	QTY	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	CODE I.D. NO. 8009 DRAWING SIZE: 11" X 17" CONST. CONT. NO. N47408— SPEC. NAVFAC DRAWING NO. 6425432 SHEET 9 OF 13 S — 1	


IF SHEET IS LESS THAN
34"x22" USE GRAPHIC SCALE

DEPARTMENT OF THE NAVY	NAVAL FACILITIES ENGINEERING SERVICE CENTER INGENIERIA, S.C.	NAVAL FACILITIES ENGINEERING COMMAND
NAVAL STATION	MOORING SYSTEM PLATE ANCHOR 5 FT X 6 FT	NORFOLK, VA

CODE I.D. NO. 8009	DRAWING SIZE: 1
CONST. CONT. NO.	N47408-
SPEC.	NAVFAC DRAWING NO.
	6425432
SHEET	9 OF 13

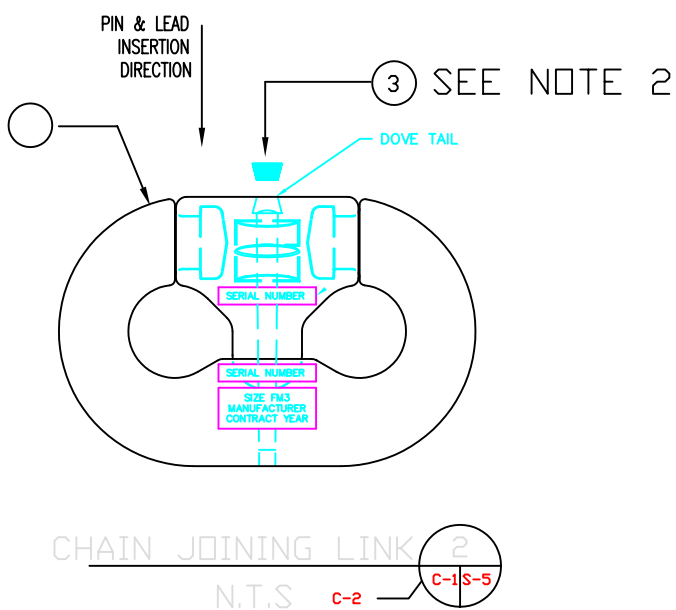
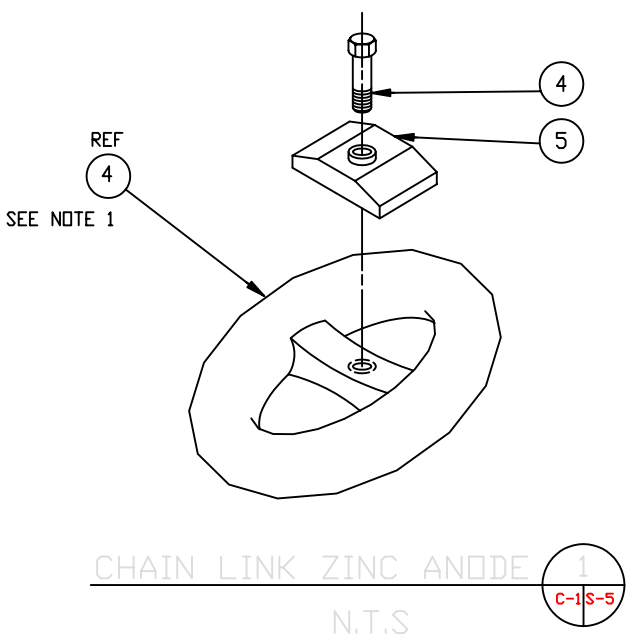
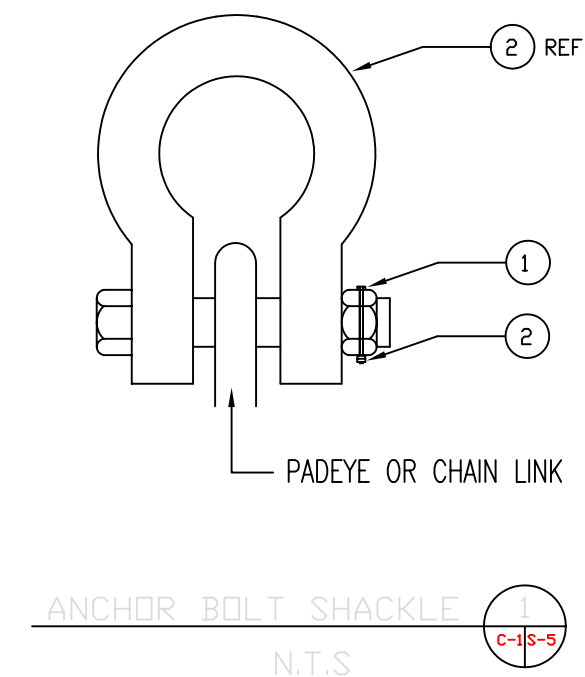


7	2	NUT 1/2" – 13UNC HEX	SAE GRADE 2
6	1	BAR 1/2"Ø x 1'-10"	ASTM A36
5	1	PLATE 1" x 2' x 3'-9"	ASTM A572-84 GRADE 50
4	2	PLATE 1/2" x 7 13/16" x 10"	ASTM A36
3	2	1/2"Ø SCHEDULE 80 x 7"	ASTM A53 GR B
2	2	1/2"Ø SCHEDULE 80 x 2 1/4"	ASTM A53 GR B
1	2	PLATE 3/8" x 9 5/32" x 1'-6"	ASTM A36
PART NO.	QTY	NOMENCLATURE OR DESCRIPTION	SPECIFICATION

CODE I.D. NO. 8009 DRAWING SIZE: 11x17 CONST. CONT. NO. N47408- SPEC.		NAVAL FACILITIES ENGINEERING SERVICE CENTER WASHINGTON, D.C.				OCEAN CONSTRUCTION DIVISION DESIGNED BY S. COHEN CHECKED BY W. SEELIG FUNCTIONAL APPROVAL APPROVED		EAST COAST DET EC W. SEELIG 551 DRAWN BY S. COHEN 552 DATE REVIEWED BY CUSTOMER DATE REVIEWED BY MOCC DATE		DESCRIPTION DEVIATIONS DATE APPROVED	
NAVAL STATION NORFOLK, VA MOORING SYSTEM PLATE ANCHOR KEYING FLAPS		NAVAL FACILITIES ENGINEERING SERVICE CENTER WASHINGTON, D.C.									
SHEET 10 OF 13		NAVFAC DRAWING NO. 6425432									
S - 2											

NOTES

- 1. NUT AND BOLT ON FIND NO. 2 SECURED USING PART NO'S 1 & 2.
- 2. FIND NO. 4 SECURED WITH A LEAD PLUG.
- 3. QUANTITY OF PARTS SHOWN IN TABLE IS FOR 1 ASSEMBLY.
- 4. SEE SHEETS C-1 & C-2 FOR TOTAL COMPONENT SUMMARY.



5	1	ANODE, CHAIN, STUD LINK, ZINC, 2.75-INCH NOM.	GALVANIZED	GOVERNMENT	CONTRACTOR
4	1	SCREW, HEX CAP, .375-16UNC-2A X 2-INCH	SEE DETAIL	GOVERNMENT	CONTRACTOR
3	1	LEAD PLUG	6% ANTIMONY	CONTRACTOR	CONTRACTOR
2	1	NUT, LOCKING, 0.375-INCH ID	STAINLESS STEEL	CONTRACTOR	CONTRACTOR
1	1	BOLT, 0.375-INCH DIA., SS318, 7-INCH LENGTH	STAINLESS STEEL	CONTRACTOR	CONTRACTOR

PART NO.	QTY	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	SOURCE	INSTALLATION
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FILE NAME: 6425435	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVAL STATION	MOORING SYSTEM	MOORING LEGS	MISCELLANEOUS DETAILS
PLOT SCALE: NO SCALE	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER

CODE I.D. NO. 80091	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER
DRAWING SIZE: D	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER
CONST. CONT. NO. N47408-	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER
SPEC.	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER
NAVAFAC DRAWING NO. 6425435	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER
SHEET 13 OF 13	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER	NAVY FACILITIES ENGINEERING SERVICE CENTER